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(71) Applicant
Peter John Gill,
6 Heath Farm Road, Codsall, Wolverhampton, West Midlands

(72) Inventor
Peter John Gill

(74) Agent and/or Address for Service
Anthony Cundy & Co,
384 Station Road, Dorridge, Solihull, West Midlands
B93 8ES

(54) Tamper resistant fasteners

(57) The driving recess of a rotatable fastener is provided with radial driving walls 7 and inclined releasing walls 8 to prevent unauthorised release of the fastener. Each releasing wall 8 comprises two flat or curved facets 8B, 8C, which cam the driver out of the recess. The driving recess may be cruciform or tri-lobular. The fastener may be a wood screw, machine screw, or self-tapping screw, and may be headless.

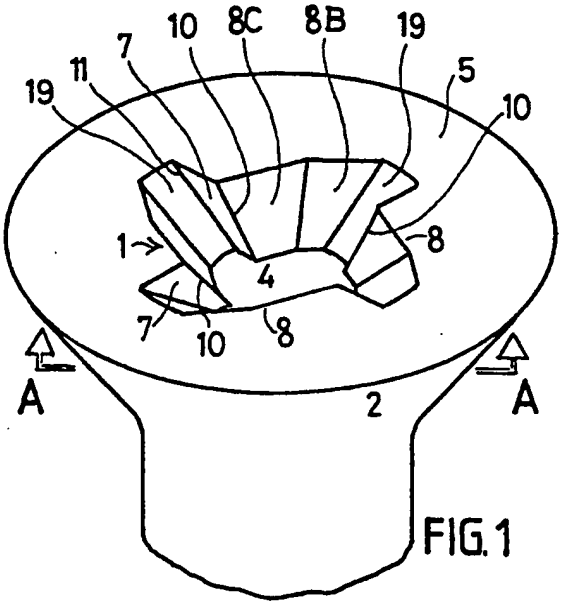

FIG.1

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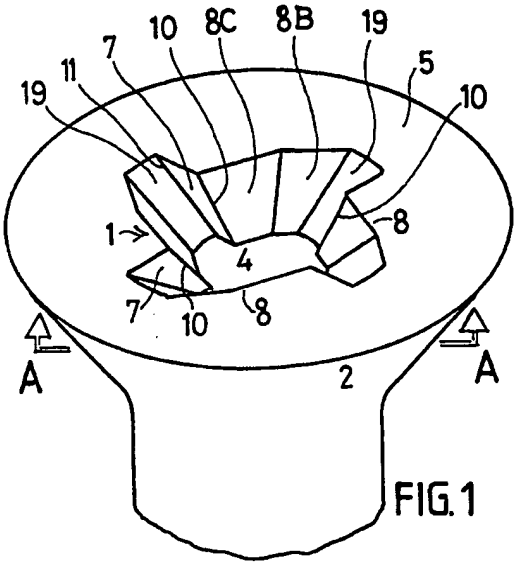

FIG. 1

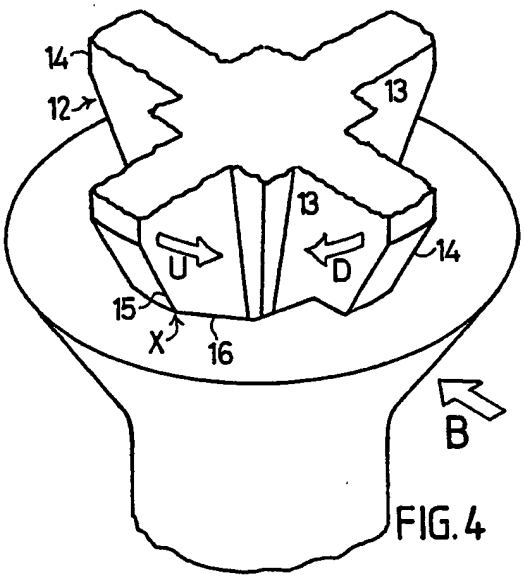

FIG. 4

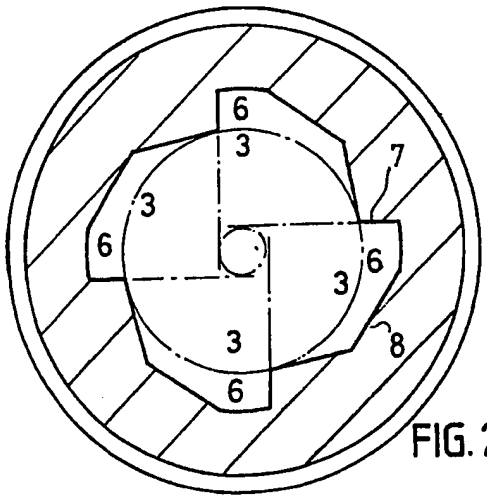

FIG. 2

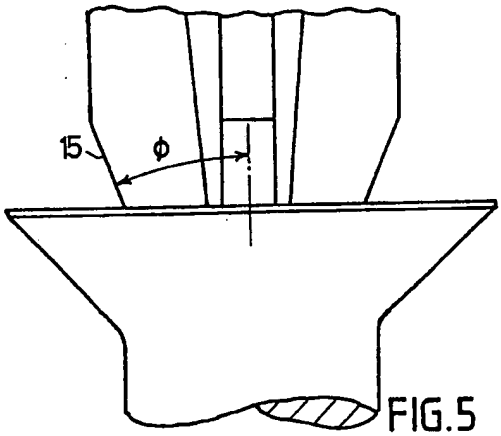

FIG. 5

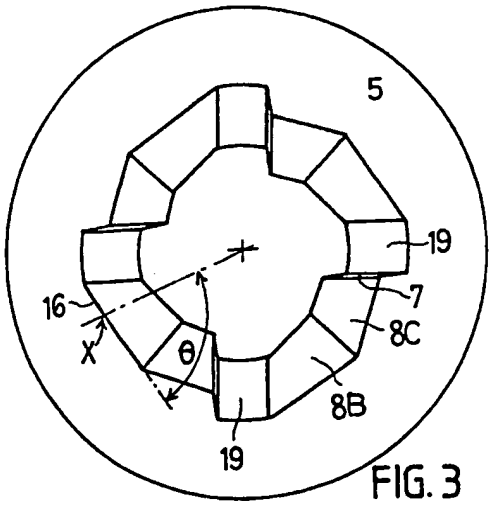

FIG. 3

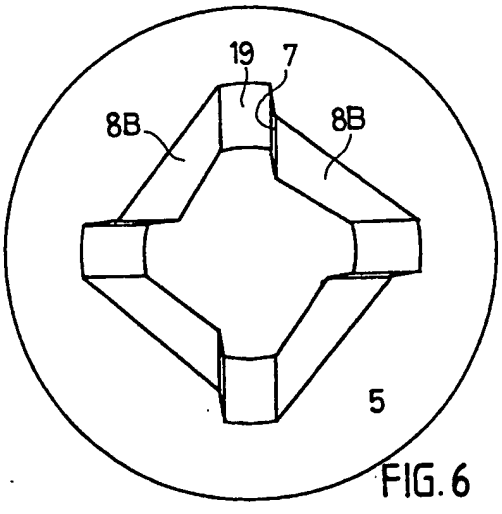

FIG. 6

SPECIFICATION

Tamper resistant fasteners

This invention relates to tamper resistant fasteners and is particularly but not exclusively concerned with tamper resistant screws, that is to say screws which subsequent to being driven are difficult to unscrew.

There are numerous known types of tamper resistant screws in current use and these can be classified into three general categories as follows:–

Category 1 is based on a design principle which incorporates a screw head having two distinct portions which are spaced apart in the axial direction by means of a groove formed around the lateral periphery. The outer or upper head portion has a driver-engaging configuration. The inner or lower head portion has the usual transverse flat abutment face which bears against the joint member which the screw is required to secure and the surface of the inner head portion between the abutment face and the groove is an uninterrupted surface of revolution. After the screw has been tightened the outer head portion is removed by severing the material at the base of the groove. The remaining inner head portion is difficult to grip and so the screw is difficult to remove. This type of screw is expensive because its manufacturing operations are unduly time consuming. Also, the rough bare metal at the severed surface can be unsightly particularly if rusting occurs.

Category 2 is characterised by a type of screw which has an unusual driving configuration which necessitates the use of a special correspondingly shaped wrench or driver which is supposedly only available to authorised users. The disadvantage with this type is that a determined felon can take steps to acquire the necessary special driver and such acquisition is likely to become easier with increasing popularity of the screw itself.

Category 3 comprises screws which are intended for use with standard flat bladed screw drivers. A screw in this category usually has on the top surface of its head two raised portions positioned approximately to occupy two diagonally opposite quadrants. These raised portions are shaped to allow the standard flat bladed screw driver to exert torque in the driving direction but to make the driver lift out of engagement with the head when torque is applied in the unscrewing direction. The disadvantages with this type are that the raised portions disfigure the standard shapes of head, also they do not afford positive location to the screw driver blade and consequently the design is unsuitable for high speed repetitive power driving applications.

The objective of this invention is to provide an improved tamper resistant fastener.

According to the present invention there is provided a tamper resistant fastener of the kind which is rotated in a fastening direction to effect a fastening and if it could be rotated in the opposite, unfastening, direction would become unfastened and which incorporates a driving formation for co-operation with a driver such that it can be driven in the fastening direction but such that it tends to make the driver slip out of engagement in the unfastening direction and wherein the driving formation comprises a recess incorporating a central depression and a plurality of cavities radiating from the depression, each cavity having a driving wall extending generally radially from the axis of the recess and a reverse wall which comprises at least one flat surface which is radially inwardly inclined in the unfastening direction and radially outwardly inclined in an axially outward direction.

The driving walls do not need to be exactly in radial planes but should be sufficiently close to radial to allow effective drive between driver and fastener.

The reverse wall may incorporate two or more flat surfaces (referred to as facets) inclined to each other such that each successive facet in a direction away from the driving face is inclined radially inward in an unfastening direction more steeply than the preceding facet.

Preferably each cavity also has an outer wall conforming to a frusto-conical surface. The cone angle may be selected to conform to a cone angle employed in a corresponding cruciform recess intended to be used with the selected driver.

Preferably the cavities are of equal size and shape. There may be four cavities to correspond to a conventional cross-head driver. For use with a 3-winged driver, for example that known by the trade mark 'Tri-Wing', three cavities are provided.

Each reverse wall may be made up of a series of flat or curved facets angled slightly between one facet and the next. Alternatively each reverse wall may be constituted by a suitably inclined planar surface.

Preferably the central depression of the recess has a shallow concave base.

By way of example only there now follows a more detailed description based on a recess which would be suitable for driving with a four wing driver. Reference will be made to the accompanying drawings wherein:–

Figure 1 is a pictorial view of a screw head with a recess embodying the invention;

Figure 2 is a transverse cross section at a level such as AA in Fig. 1, viewing in a direction opposite to that of driver entry;

Figure 3 is a plan view of the top surface of the head shown in Fig. 1;

Figure 4 is a pictorial view showing the head of Fig. 1 engaged with the working portion of a typical proprietory driver;

Figure 5 is a side elevation of the head and

driver combination of Fig. 4 viewed in a direction such as shown by the arrow B; and

Figure 6 is a view corresponding to Fig. 3, showing a modification.

Referring to the drawings, a recess 1 is shown in a countersunk head 2 of a fastener such as a screw. The recess may alternatively be formed in any other style of screw head or in an end of a headless screw. The recess can be formed in a screw having threads of any desired configuration such as wood screw threads, machine screw threads or self tapping screw threads. The recess may also be formed in other kinds of rotatable fasteners besides screws.

The recess has a central depression 3 defined in part by a notional inverted truncated cone. The depression 3 has a base 4 which is of shallow concave shape and the end of the depression opposite to the base 3 coincides with the top surface 5 of the head 2.

Extending radially outwards from the central depression 3 are four equal cavities 6 which are open topped and bounded laterally by driving walls 7 and reverse walls 8. Driving walls 7 are flat so that when the recess 1 is engaged by a suitable proprietory cross-head driver 12, such as that known as a Phillips driver or that known as a Pozidriv (Registered trade mark) driver, the driving faces 13 thereof abut said driving walls 7 to transmit driving-in torque into the material which surrounds the recess. The driving walls 7 extend generally radially with respect to the axis of the screw. In particular these walls 7 must be sufficiently close to actually lying in radial planes to allow effective drive between driver and screw. Any deviations from radial planes are intended to adapt the recess to a proprietory driver and may originate from the need to incorporate a small draft angle in order to ease the withdrawal of the tools which are used in the manufacturing operation of recess forming. The planes of the driving walls 7 are also each set back from a radial plane such that their intercepts are tangential to an imaginary cylinder 9 which is centred on the axis of the recess and which has a diameter corresponding approximately to the thickness of a wing 14 of the intended driver 12. The inner boundary edges 10 of the driving walls 7 may be considered as generators of an inverted truncated cone referred to as the "inner cone" which defines the central depression 3.

The outer lateral boundary edges 11 of the driving walls 7 are equally inclined to and equally spaced from the axis of the recess and they can therefore be regarded as generators of a coaxial inverted truncated cone referred to as the "outer cone".

Preferably each recess 6 has an outer wall 19 with an approximately rectangular outline one side edge of which is one of the outer boundary edges 11 and the width of said facet is just in excess of the thickness of a wing 14 of the type of driver 12 for which the recess is designed. The surface of the wall 19 is a portion of the surface of the outer cone.

Each cavity 6 has a reverse wall 8 which may comprise a single planar face or facet as shown in Fig. 6; the plane of this face is inclined radially outward considered in a direction from the base of the recess along the recess in an axially outward direction. It is also inclined inward when considered in a circumferential direction away from the driving wall 7.

Alternatively, as illustrated in Figs. 1 to 3, each reverse wall may have a number of facets 8B, 8C, etc., inclined to one another at an oblique angle but each retaining a general inward inclination in a circumferential direction away from driving wall 7 and an outward inclination in an axial direction out from the recess. The inward inclination increases from facet to facet in a direction away from the driving wall 7.

In providing tooling, in particular punches, for the manufacture of recess head fasteners, it is normally necessary to start with a master punch from which production punches are produced indirectly and to employ the production punches to punch out corresponding recesses in fasteners. The provision of one or more flat facets on the reverse wall 8 results in a shape which can be manufactured consistently and reliably on a master punch and thus can eventually be reporoduced in a fastener recess.

A fundamental requirement for each reverse wall 8 is that it should be inclined radially inward in the unfastening direction of rotation and radially outward in an axially outward direction.

When a driving-in torque is applied to the screw by the driver, rotation of the driver 12 is in the direction D and the driving faces 13 of said driver make nominal flat face-to-face contact with the driving walls 7 of the recess as is the case in the use of known conventional drivers and recesses of the multi-wing type and screw insertion therefore takes place in the normal way.

When attempts are made to unscrew a screw having the recess 1, rotation of the driver is applied in the direction U. In this case flat face-to-face contact between the driver and the walls of the recess cannot occur: the only contacts possible are very localised and may loosely be termed "point contacts". These point contacts occur at points such as X at the intersection of on the one hand the corner edges 15 of the wings 14 of the driver 12 and on the other hand the recess edges 16 which are formed by the intersections of the reverse walls 8 and the top surface 5 of the head 2. With this type of contact there is a component of force in the axial direction tending to push the driver 12 out of the recess 1 and this component of

force increases as the angles θ and ϕ approach 90°, where θ is the angle between the radius at X and the tangent to the edge profile 16 at X (see Fig. 3), and where ϕ is the semi vertex angle of the cone of the envelope of the wings 14 of the driver 12 (see Fig. 5).

In order to prevent an edge of the driver from digging in to a reverse wall 8 and thus establishing inadvertent reverse drive, it is preferred that the material of the head should be surface hardened.

The magnitude of the angle ϕ is fixed in the manufacture of the drivers which are likely to be used in attempts to unscrew screws having recesses according to this invention. On the other hand the design of recesses according to this invention enables the angle θ to be given a magnitude sufficient to ensure that the outwardly acting component of force on the driver will be high enough under normal circumstances to eject it from the recess rather than allow it to exert a significant amount of unscrewing torque thereon.

CLAIMS

1. A tamper resistant fastener of the kind which is rotated in a fastening direction to effect a fastening and if it could be rotated in the opposite, unfastening, direction would become unfastened and which incorporates a driving formation for co-operation with a driver such that it can be driven in the fastening direction but such that it tends to make the driver slip out of engagement in the unfastening direction and wherein the driving formation comprises a recess incorporating a central depression and a plurality of cavities radiating from the depression, each cavity having a driving wall extending generally radially from the axis of the recess and a reverse wall which comprises at least one flat surface which is radially inwardly inclined in the unfastening direction and radially outwardly inclined in an axially outward direction.

2. A fastener as claimed in Claim 1 wherein the reverse wall incorporates two or more flat surfaces (referred to as facets) inclined to each other such that each successive facet in a direction away from the driving face is inclined radially inward in an unfastening direction more steeply than the preceding facet.

3. A fastener as claimed in Claim 1 or Claim 2 wherein each cavity has an outer wall conforming to a frusto-conical surface.

4. A fastener as claimed in Claim 3 wherein the cone angle is selected to conform to a cone angle employed in a corresponding cruciform recess intended to be used with the selected driver.

5. A fastener as claimed in any one of the preceding claims wherein the cavities are of equal size and shape.

6. A fastener as claimed in any one of the preceding claims wherein there are four cavities to correspond to a conventional cross-head driver.

7. A fastener as claimed in any one of Claims 1 to 5 wherein there are three cavities.

8. A fastener as claimed in any one of the preceding claims wherein each reverse wall is made up of a series of flat or curved facets angled slightly between one facet and the next.

9. A fastener as claimed in any one of Claims 1 to 7 wherein each reverse wall is constituted by a suitably inclined planar surface.

10. A fastener as claimed in any one of the preceding claims wherein the central depression of the recess has a shallow concave base.

11. A tamper resistant fastener substantially as described with reference to and as illustrated by Figs. 1 to 5 or Fig. 6 of the accompanying drawings.

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